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(54) Radio station

(57) Radio station constituting a base station for a telecommunication system for wireless telecommunication to/from mobile radio units. The radio station comprises a transmitter unit (8), a receiver unit (7, 9, 11) and a number of antennas (5, 6), and means for diversity reception. The station is expandable with several units (2-4), each one of which comprising an antenna (5, 6) and being arranged at a predetermined distance from one or several antennas in the other units. The antennas forming part of each unit are adapted for reception with space diversity in cooperation with at least one antenna in any of the other units. The antennas within each unit can receive signals with different directions of polarization. The means for diversity reception generates an optimal input signal to the receiver unit by means of an evaluation of input signals from the antennas. The input signals originate from the reception with the antennas which are arranged at different positions in space and also from the reception with different directions of polarization.

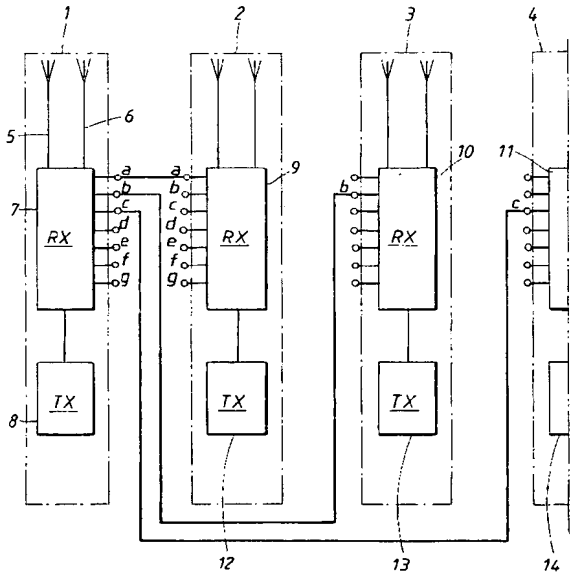

FIG.1

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Description

FIELD OF THE INVENTION:

The present invention relates to a stationary radio station according to the preamble of appended claim 1.

The present invention relates more particularly to a radio station which constitutes a base-station for a wireless telecommunications system for telecommunication to/from mobile radio units which are within the station's area of coverage.

With wireless telecommunication, the strength of the signal can vary to a large degree between different positions of a receiver antenna. This very local variation is due to fading caused by multi-way propagation, which in turn is due to reflections in the environment.

BACKGROUND TO THE INVENTION:

It is known to solve this problem by so-called diversity reception. Today there are mainly two different types of diversity reception and it is known to use, in one and the same system, either so-called space-diversity or so-called polarisation-diversity. Space-diversity means that two or more receiver antennas are placed at a suitable distance from each other so that the different antennas are not effected by fading, due to multi-way propagation, at the same time; see for example EP 0 517 196 A2. Polarisation-diversity means that radio signals are received both with horizontal and vertical polarisation, either in one and the same antenna with two feeders, one for each polarisation, or with two antennas, whereby due to different polarisation, fading does not occur at the same time in respective feeders or antennas.

The antennas are coupled to a common unit which presents means for selecting the strongest signal at that time, or for combining signals in order to obtain the best possible signal-noise ratio. There are a plurality of well-known algorithms for selecting/combining the signals, e.g. MRC.

The diversity gain i.e. the sensitivity of the receiver, increases with the number of independent channels, for which reason it is desirable to lay out a large number of antennas. A disadvantage with the solutions known up until now is that they require a great deal of space and are very costly. With space-diversity, the antennas namely need to be placed a certain minimum number of wavelengths from each other. Even with polarisation-diversity, an increased space requirement exists. Since the units are often installed in places which are positioned high-up and are thereby difficult to access, the installation cost is a very large part of the total system cost and is in proportion to the number of necessary units.

At the same time as large problems can arise in highly built-up areas due to multi-way propagation, there are economic as well as aesthetic reasons giving rise to a desire to minimize the number of antennas and radio units.

SUMMARY OF THE INVENTION:

The object of the present invention is to produce a radio station, with which the inconveniences of multi-way propagation are alleviated, at the same time as the number of antenna units/radio units is limited.

Said object is achieved by means of a radio station according to the present invention, the characterising features of which are defined in appended claim 1.

By combining the space-diversity as well as the polarisation-diversity, a noticeable diversity gain can be achieved even with two antennas which can be expanded (built-out) in pairs, in modules, together with additional antenna units/radio units.

BRIEF DESCRIPTION OF THE FIGURES:

The invention will now be described in more detail by means of an embodiment and with reference to the accompanying drawings, in which:

Fig. 1 schematically shows an example of a base-station which is built up of a number of units according to the invention,

Fig. 2 and Fig. 3 show an example of the mechanical construction of a unit included in the base-station,

Fig. 4 and Fig. 5 show an example of a stand for mounting of the unit on a foundation (base),

Fig. 6 shows an example of the way of mounting, during mounting of the units, whilst

Fig. 7 shows an alternative mounting of the units.

DESCRIPTION OF PREFERRED EMBODIMENTS:

Fig. 1 schematically shows the construction of a base-station or cellular station included in a wireless radio communications system for communication to and, respectively, from mobile telecommunications units, so-called mobile telephones. The base-station also communicates with the fixed wire-based telecommunications network and forms the link between a mobile telephone system and the fixed telephone system. The base-station is constructed of a number of units 1-4 which, in the shown example, are four in number but can vary from one up to many units depending on the particular requirements. At the same time as it is desired that the cellular station be as space-saving as possible, there is therefore also a desire to allow an extension of the base-station according to the local requirements. The strength of the incoming radio signal can be very varied from one point in space to another point depend-

ing on the local conditions and with resulting multi-way propagation. By building up the units in separate modules, a base-station can be expanded in a modular fashion, whereby the required sensitivity can be achieved by complementing with a desired number of units. Each unit 1-4 consists of at least one antenna, in the shown example two antennas 5, 6, whilst at least one of the units presents a receiver unit 7 and a transmitter unit 8. If each unit is provided with a transmitter unit, a corresponding degree of transmitter power being built up when expanding the sensitivity can be achieved. Included in the receiver unit 7 are means for diversity reception, i.e. for choosing or combining, with a per-se known calculation method, in the form of e.g. software for control of a microprocessor, the input signal from respective antennas 5, 6 for selecting the strongest signal at that time, or for combining both signals so as to obtain the best possible signal-noise ratio. For this purpose, the units 1-4 are physically placed at a mutual distance. By means of this physical mutual distance between the units, so-called space-diversity can be made use of. According to the invention, both of the antennas 5, 6 are also arranged to receive incoming signals with horizontal as well as vertical polarisation. This occurs either due to each antenna 5, 6 being provided with feeders for horizonal as well as vertical polarisation, or the respective antenna being provided with feeders for horizontal polarisation or for vertical polarisation. In this way each one of the units 2, 3, 4 is provided with a single antenna for the polarisation which gives space-diversity with antennas in other units. In this way, space-diversity as well as polarisation-diversity are combined according to the present invention, whereby by maintaining a minimum number of antennas an appreciable sensitivity increase can be achieved. It should thereby be ensured that the units 1-4 are placed at a minimum mutual distance to that unit, with which space-diversity is to be created, which distance can for example be 2 λ, were λ is the wavelength of the emitted signal. The distance is however dependent on a plurality of different factors, such as the surrounding environment and it can therefore vary.

Additionally, each receiver unit 7, 9, 10, 11, is provided with N inputs a-g intended for connection to each one of the corresponding inputs in each additional receiver unit which is to be connected to the first unit for expansion of the base-station. Said means for diversity-reception, which can make use of a per-se known diversity algorithm, are thereby prepared to accept N connections for N additional units 2, 3, 4, which can be connected to the first unit 1. In principal, all of the units can be identical in order to allow a rational modular expansion of a base-station, but the complementing units for example, or certain of them, can be provided with transmitter units, 12, 13, 14 having higher power in order thereby to provide flexibility in the expansion needs, or transmitter units can be left-out for example where only an increase in the reception sensitivity is of interest. Alternatively the expansion units may consist of only antennas, each of which is connected to its own one of the inputs a-g in the ground unit 1.

The units can be combined in different ways, for example all of the expansion units 2, 3, 4, can be connected to the first unit 1, whereby the unit 2 is connected with its input a to the input a of the first unit, the third unit 3 with its input b being connected to the input b of the first unit etc. In each one of the units, antennas with polarisation-diversity are thus included and they create space-diversity with any of the other units.

Fig. 2 and Fig. 3 show an example of the mechanical construction of a radio unit 1. Each radio unit 1 is, for example, constructed as a relatively flat, standing body with a casing 15, one side 16 of which and possibly also the opposite side 17 of which are made of a material, e.g. suitably a plastics material, which lets through radio waves of the type concerned. In this way both the antennas 5, 6 in each unit 1 can be placed within the casing which thereby protects the whole unit mechanically and environmentally from external influence. The casing 15 is provided with attachment means 18, 19, which in the shown example are placed at the top and at the bottom respectively, in order to allow a simple and rapid mounting to an attachment bracket 20, which is shown in one example in Fig. 4 and Fig. 5. The attachment bracket 20 in the shown example is formed as a U-shaped yoke with a lower leg and an upper leg 21, 22, with attachment means 23, 24 which are formed for engagement with the attachment means 18, 19 on the unit 1. The upper attachment means on the unit 1 may be formed for example as one or more forks for gripping around a profile on the attachment bracket's upper leg 22. In a corresponding manner, projections 19 at the lower end of the radio unit can engage with a channel which forms the lower attachment means on the attachment bracket 20. The attachment bracket 20 is, in turn, provided with attachment means 25, 26 in the form of e.g. screws passed though holes in the bracket for screwed attachment to a foundation, for example a pillar or wall.

Fig. 6 shows a modified attachment bracket 27 which is based on the same attachment principal as the bracket according to Fig. 4 and allows mounting entirely without the use of tools, this being visible in the Figure. The unit 1 is simply mounted by means of its upper attachment means 18 being pushed in from below into the upper leg's 22 attachment means 24, upon which the unit is moved down from above with its lower attachment means 19 so that they rest in the channel 23 in the leg 21. The attachment bracket according to Fig. 5 is arranged for attaching at least two units 1, 2, but if the legs are made longer, a larger number can be attached. Alternatively, a plurality of legs can be attached in a row or in another way in a predetermined pattern.

Fig. 7 additionally shows an alternative fixing arrangement for attaching a number of units 1, 2, 3 to a foundation, which in the shown example is constituted

by a pillar 28. In this embodiment, the legs 29 of the bracket are T-shaped, whereby the radio units can be kept at a distance from the foundation and can face outwardly from this. The same bracket can also be used for planar foundations, whereby the radio units can be placed in rows.

Common to all the mounting alternatives is that the attachment arrangements for the units allow a predetermined and accurate selection of the position of each unit, both relative to the surroundings as such and also between each other, so that antennas in the units have a suitable chosen position relative to other units. In this way, expansion is facilitated without the need for accurate distance measurement each time expansion occurs and space is saved since each unit is equipped for double diversity reception together with at least one additional unit, i.e. space-diversity as well as polarisation-diversity, whereby aesthetic gains are also achieved. Since fewer units are required for a particular level of sensitivity, house facades and the like do not have to be cluttered up.

The invention is not limited to the embodiments described above and shown in the drawings, but can be varied within the scope of the appended claims. For example, more than two antennas can be used for each unit. Each unit can also comprise more than one receiver unit. Even if it is not necessary, antennas in the different units can advantageously be identical with respect to their antenna diagram, i.e. directionally dependent sensitivity.

Claims

1. Radio station constituted by a base-station for a telecommunications system for wireless telecommunication to/from mobile radio units, whereby the radio station includes a transmitter unit (8), a receiver unit (7, 9, 11), a number of antennas (5, 6) and means for diversity reception, characterised in that the station is expandable with a number of units (2-4), each of which comprises at least one antenna (5, 6) and which is arranged to be placed at a predetermined distance from one or more antennas in other units and in that the antenna(s) included in each unit is/are arranged for reception with space-diversity in cooperation with at least one antenna in any of the other units, and in that said antenna or antennas within each unit is/are arranged for reception of signals with different polarisation directions for achieving polarisation-diversity, and in that said means for diversity-reception are arranged to produce an optimum input signal to the receiving unit by evaluation of the input signals from said antennas, which input signals originate both from said reception from the antennas with different placement in space and from said reception with different polarisation directions.

2. Stationary radio unit according to claim 1, characterised in that said base-station is constituted by at least a first unit (1) with one or more antennas (5, 6), a transmitter unit (8) and receiver unit (7) and one or more separate units with one or more antennas, whereby said means for diversity-reception present a number N of inputs (a-g) for connection between said first unit (1) and other units (2-4).

3. Stationary radio unit according to claim 2, characterised in that each unit presents an attachment arrangement (20) which is arranged to ensure a predetermined placement of each unit relative to other units in respect of mutual distance as well as direction.

4. Stationary radio unit according to claim 1, characterised in that all of the antennas (5, 6) have mutually equal antenna characteristics.

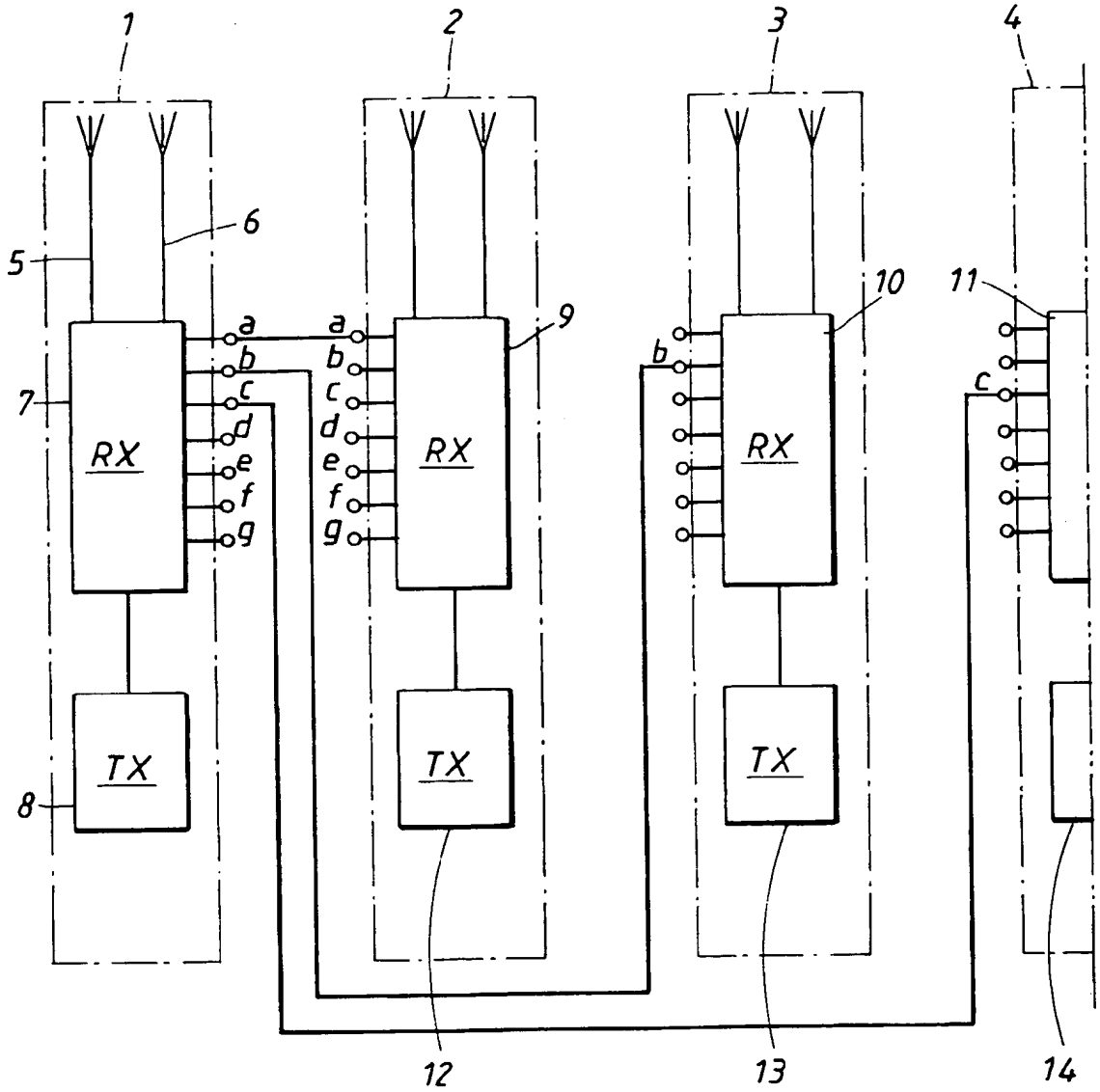

FIG.1

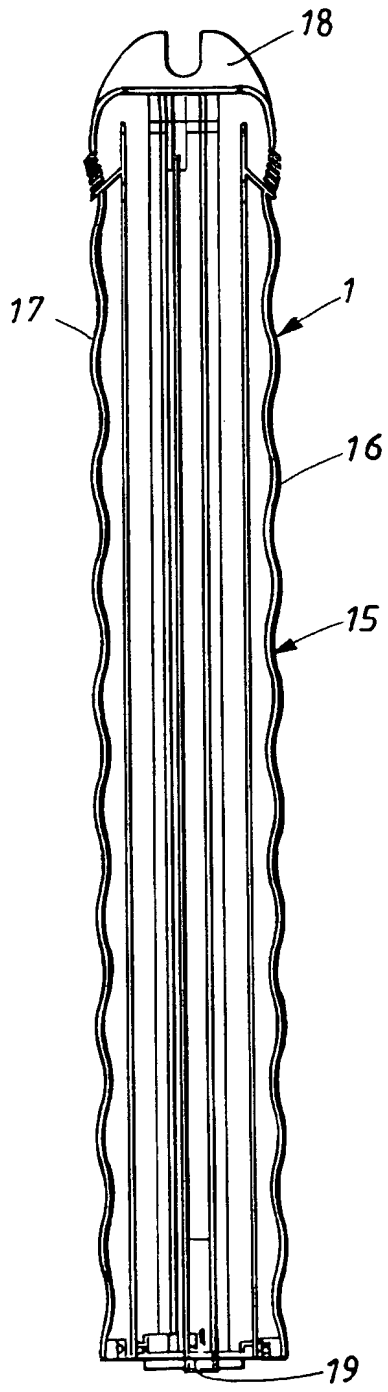

FIG.2

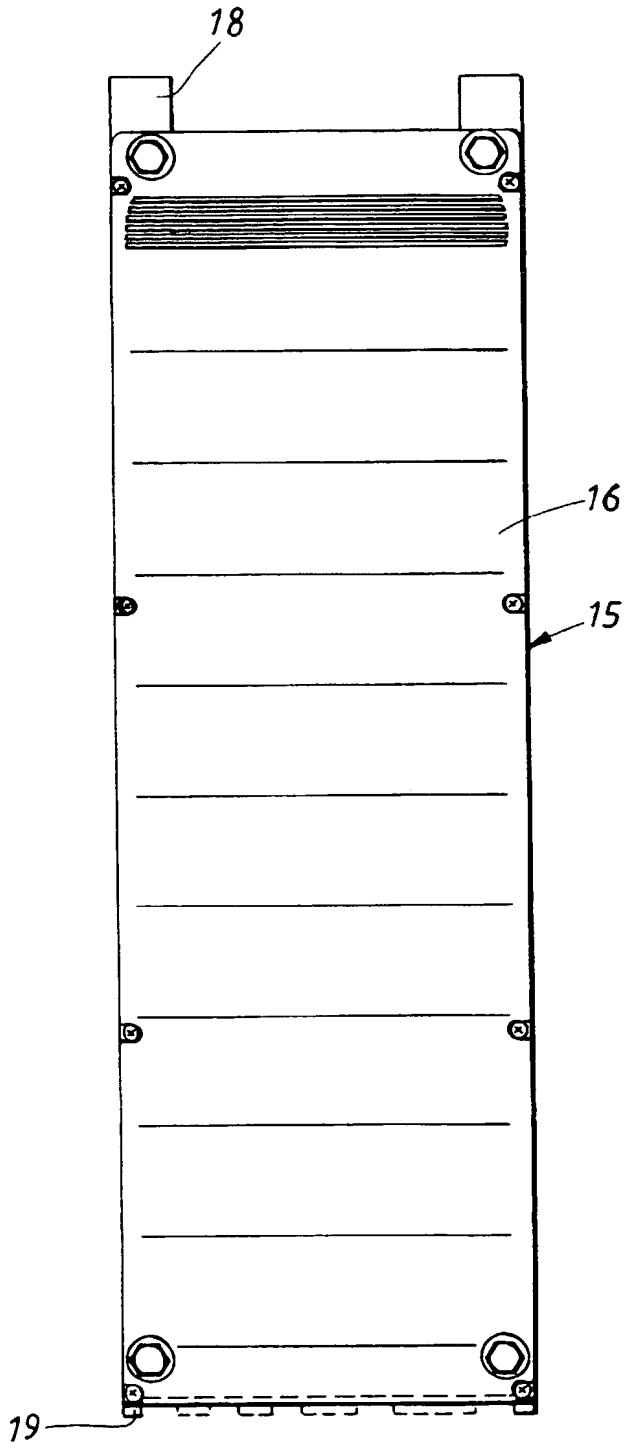

FIG.3

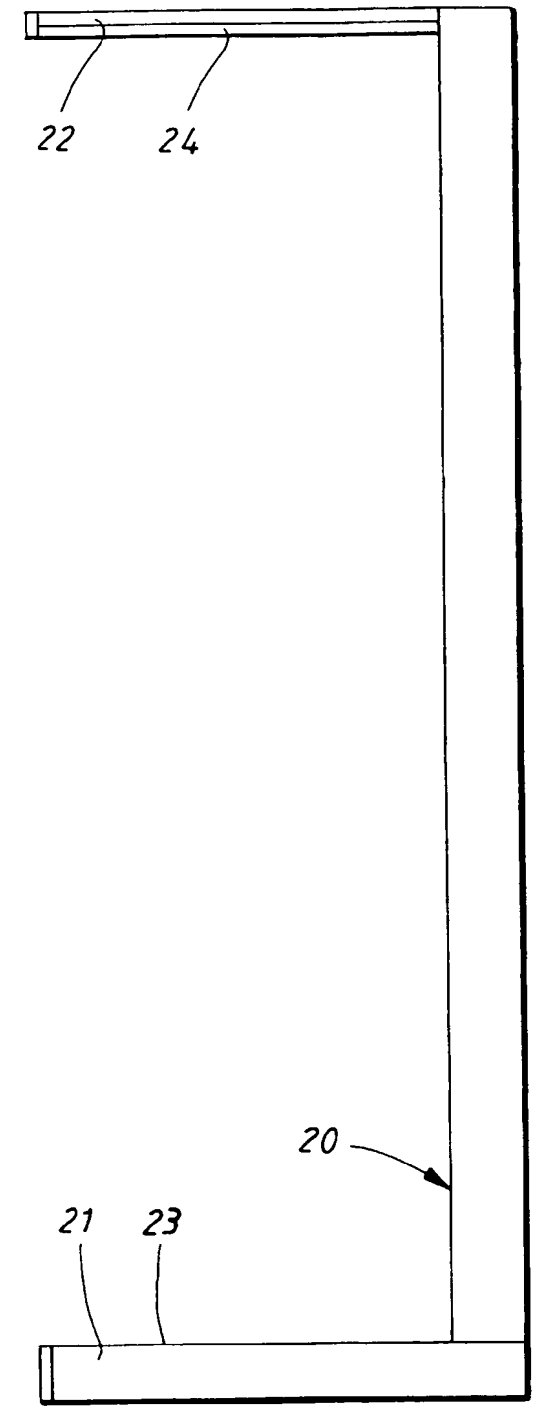

FIG.4

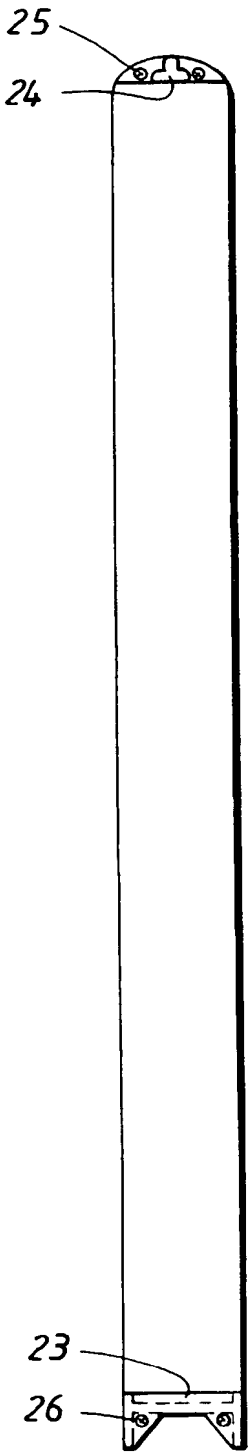

FIG.5

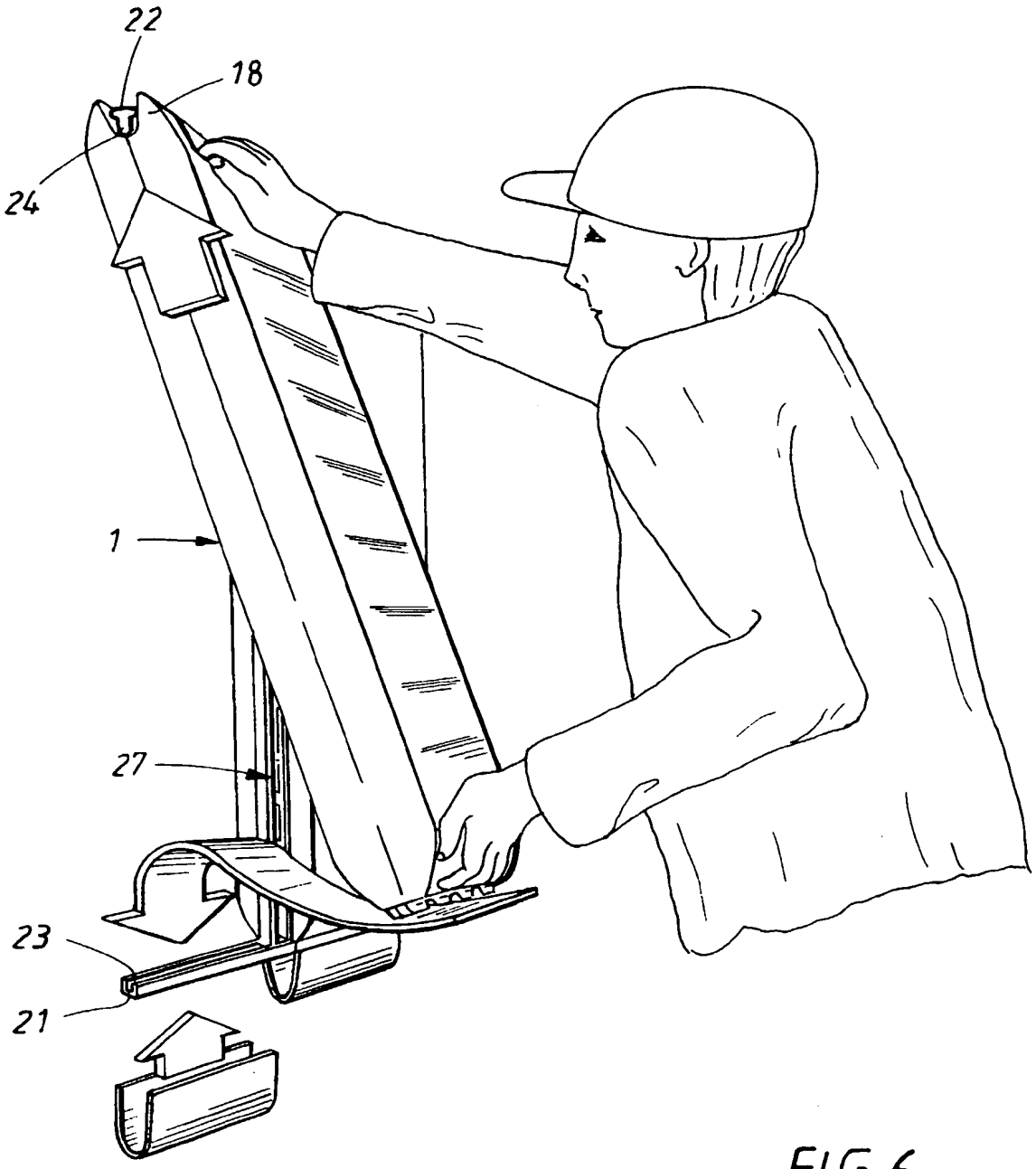

FIG.6

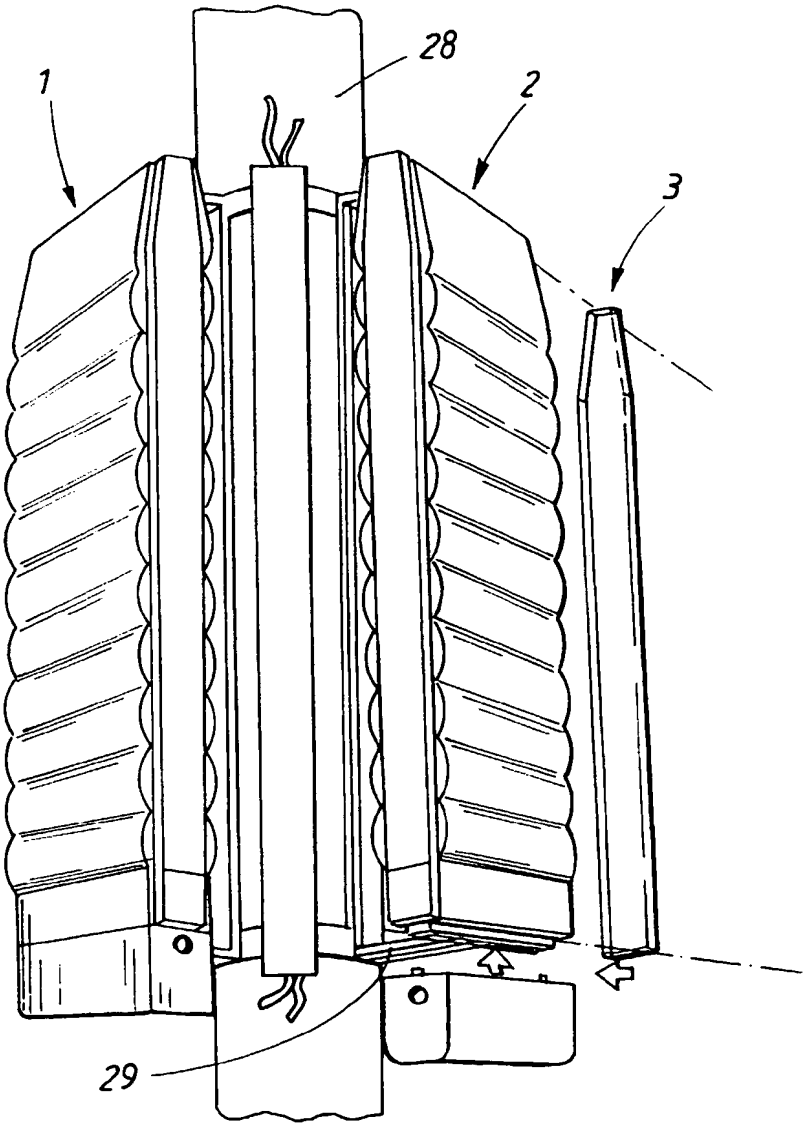

FIG. 7

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 96 85 0157.7

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.6)
A	GB, A, 2257605 (PAUL VICTOR BRENNAN), 13 January 1993 (13.01.93) * abstract * --	1-4	H04B 7/04
A	EP, A2, 0272510 (SIEMENS AKTIENGESELLSCHAFT BERLIN UND MÜNCHEN), 29 June 1988 (29.06.88) * abstract * -----	1-4	

TECHNICAL FIELDS SEARCHED (Int. Cl.6)

H04B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
STOCKHOLM	20 December 1996	SOLLERHED MIKAEL

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
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E : earlier patent document, but published on, or after the filing date
D : document cited in the application
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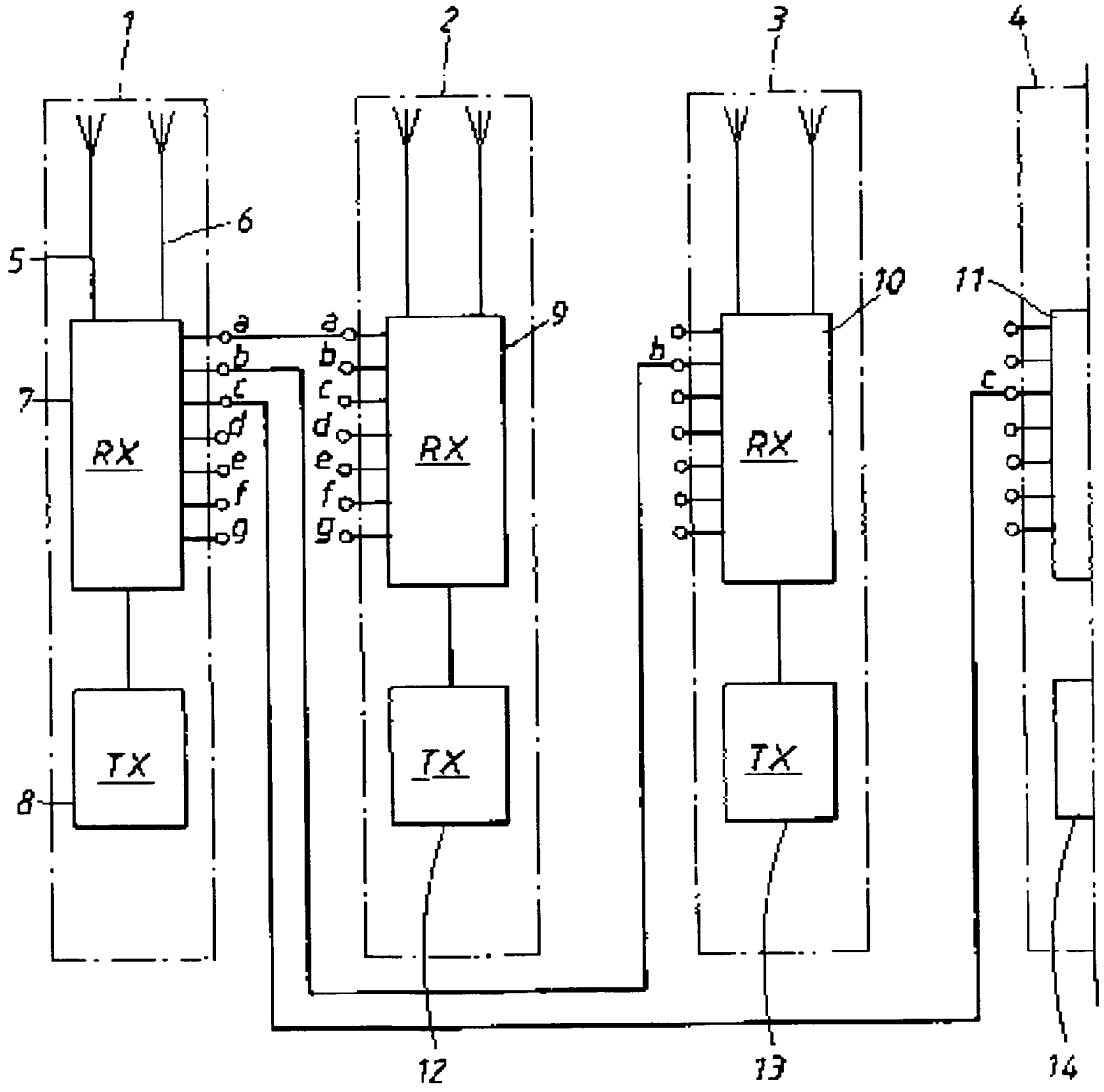

FIG.1

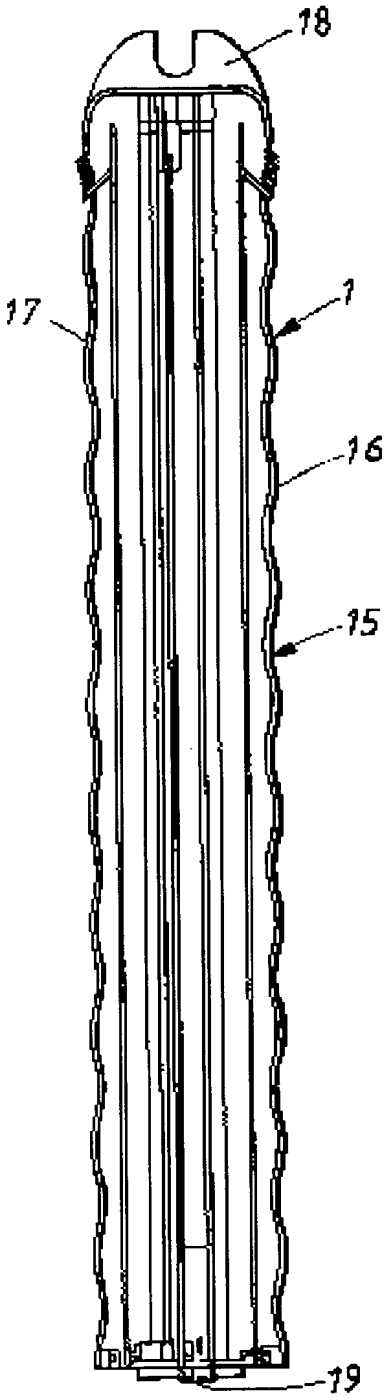

FIG.2

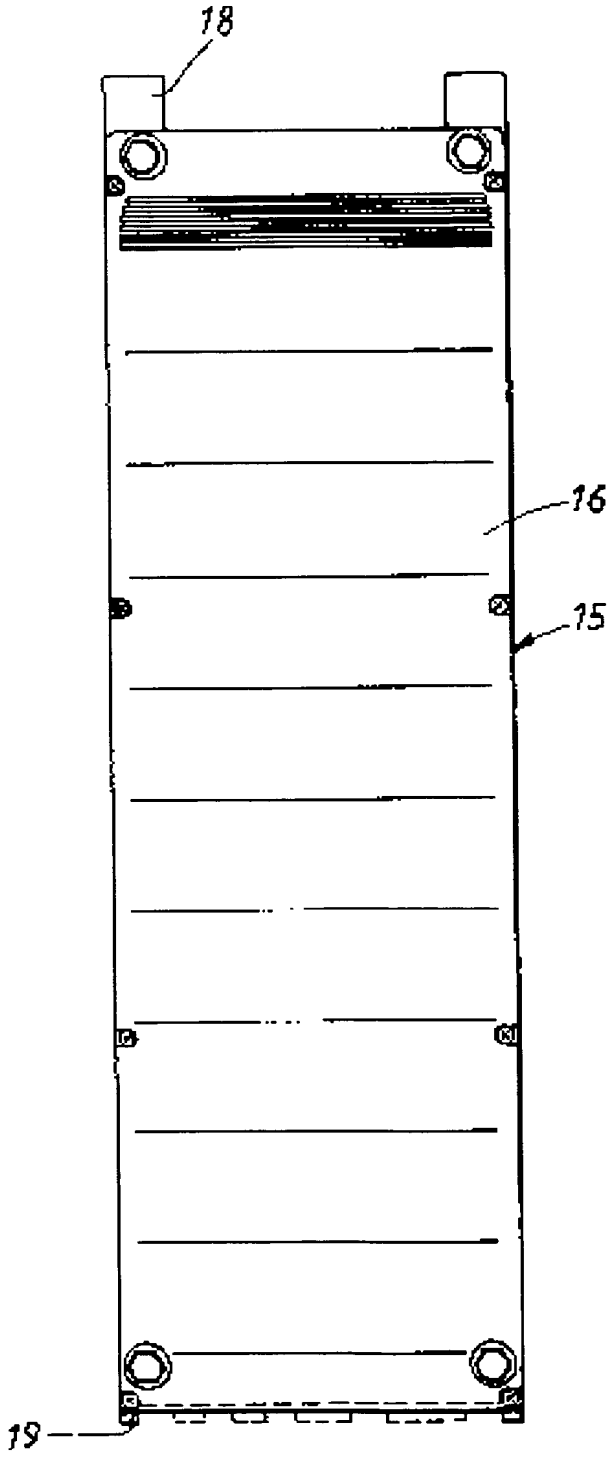

FIG.3

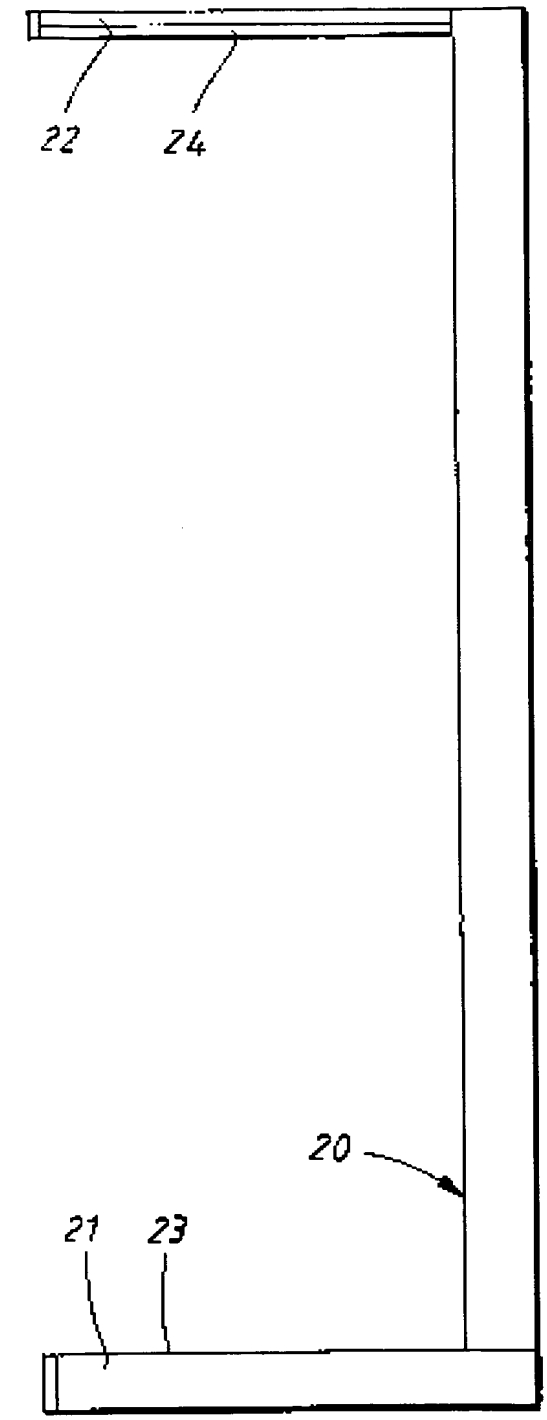

FIG.4

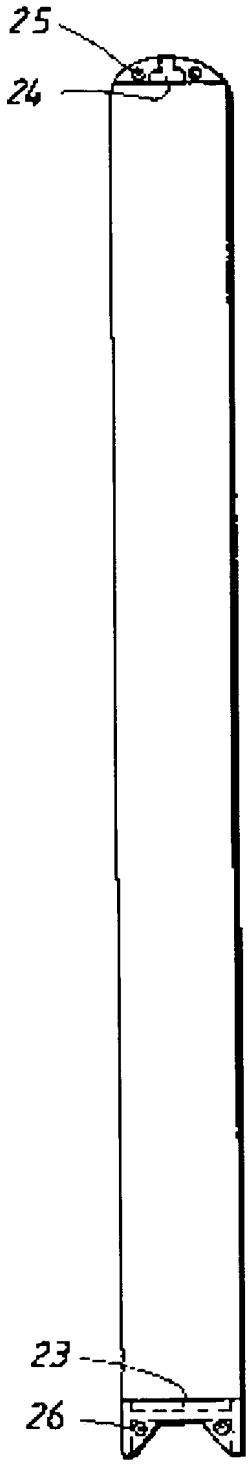

FIG.5

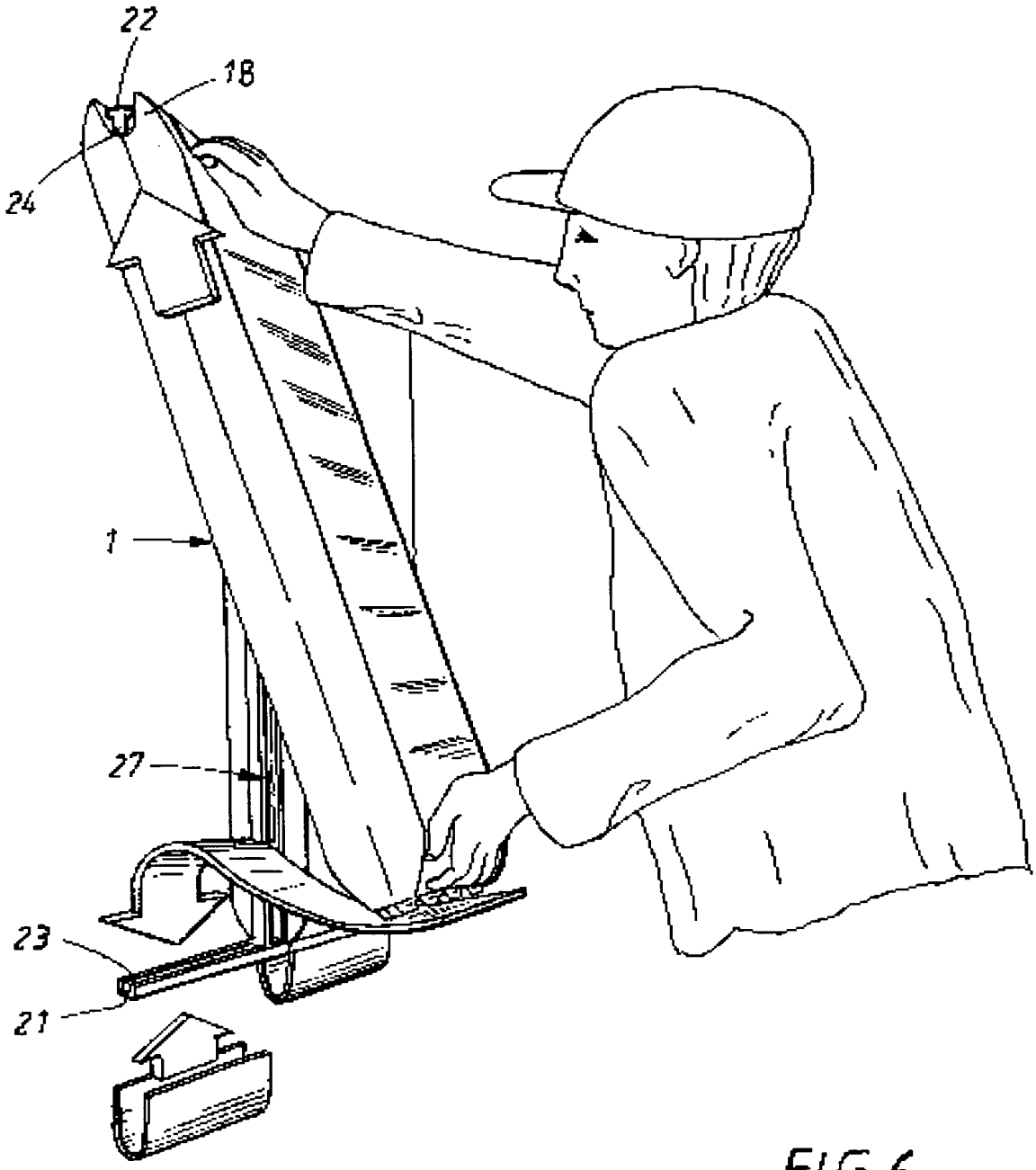

FIG.6

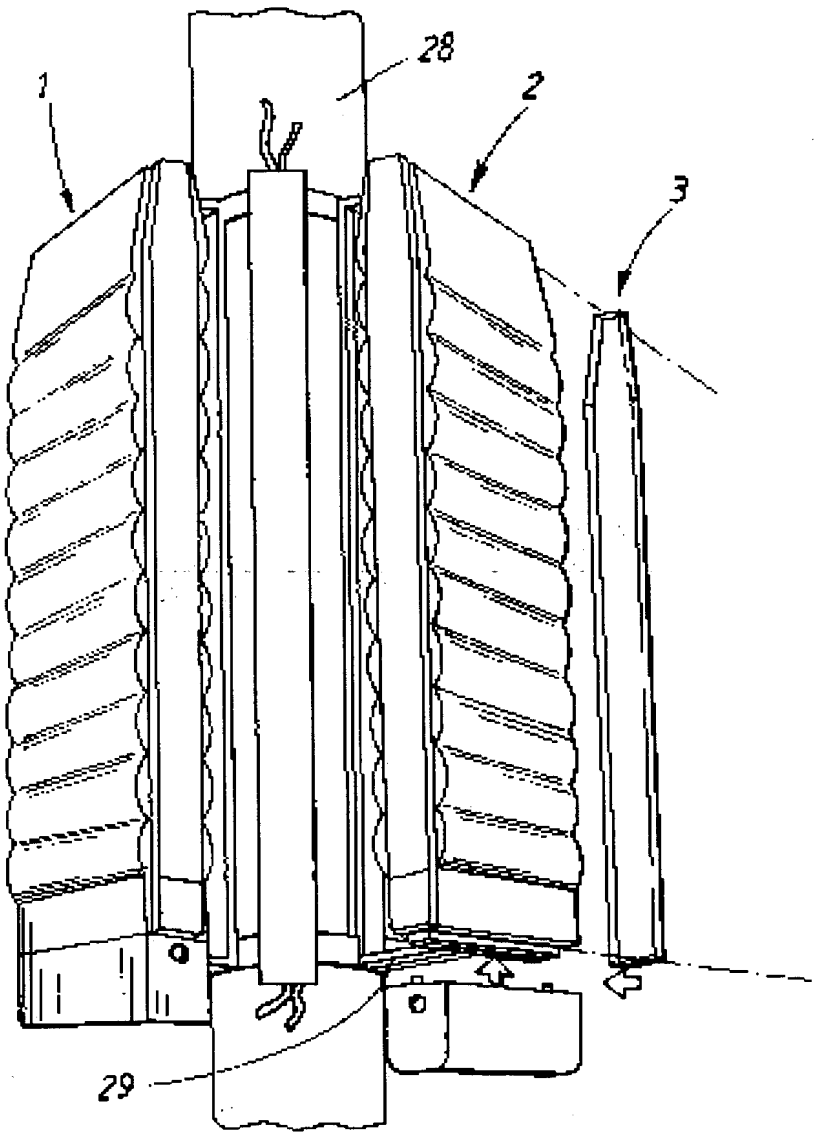

FIG. 7